Research to Risk Assessment (R2RA)

Draft Progress Report – June 2013

Executive Summary

The goal of the Research to Risk Assessment (R2RA) Work Group project is to improve the environment and public health. The approach is to proactively promote the application of innovative Superfund Research Program (SRP) research with SRP's U.S. Environmental Protection Agency (EPA) and Agency for Toxic Substances and Disease Registry (ATSDR) partners, to the mutual benefit of all. The R2RA Work Group met its first year's goals by launching an interagency partnership with experienced staff/managers who are now pursuing mutually beneficial collaborative pilot efforts.

This interagency Work Group is comprised of a group of scientists and managers with extensive experience in their fields of science or program implementation, and who are motivated to develop innovative science applications to meet their program and research needs. The group includes representatives from EPA Headquarters (HQ) risk assessment programs, regional programs, research programs, and ATSDR HQ and regional health assessment programs.

The focus of the Work Group in its first year was to agree on a collaborative approach to identify EPA and ATSDR program needs with SRP grantee research projects. Regarding key accomplishments, the R2RA Work Group has:

- Developed a collaborative approach to screening research programs and matching critical program needs with SRP research results and research scientists to accelerate research translation in critical areas.
- Collaboratively identified a critical study need at both the national and regional levels with regard to PCBs inhalation health effects and has developed an interagency agreed upon study design. The University of Iowa SRP research Center is prepared to implement a robust inhalation toxicity study that can serve as the basis for a reference concentration for EPA. This is intended to fill a critical research gap and reduce the potential uncertainty associated with the clean-up of this widespread toxicant.
- Provided site-specific technical assistance by SRP researchers on sites with soil vapor intrusion and have initiated SRP-EPA HQ discussions on potential longer term collaboration.
- SRP researchers are working with an EPA regional office on assessing the risks posed by a contaminated sediment megasite using state of the art passive sampling technologies

- SRP researchers are working with EPA risk assessors in evaluating the use of phosphate amendments to treat lead-contaminated soils. This may often involve a variety of potential exposures, including urban gardening settings.
- Several shorter term “spin-off’ projects involving SRP scientists are providing real-time assistance on EPA site-specific risk assessment issues.

The future plans or the R2RA Interagency Work Group are to complete the ongoing pilots, refine the approach for future pilots based on successes and lessons learned, and address the longer term challenge of advancing the interdisciplinary science underpinnings supporting research applicable to risk assessment.

Concept of the R2RA Project

The National Research Council formally addressed the need to update the risk assessment process in 2009 in its publication "Science and Decisions: Advancing Risk Assessments." This report stimulated widespread discussion of the issue by private sector stakeholders as well as state and federal agencies. Communities affected by hazardous waste increasingly demand more responsive risk assessments that incorporate recent advances in genomics, cumulative chemical exposure, and toxicity assessment. The U.S. Environmental Protection Agency's (EPA) risk assessment and the Agency for Toxic Substances and Disease Registry's (ATSDR) health assessment procedures used in the Superfund program had not seen major advancement since their development in the late 1980s. In the meantime, new research emerged with direct relevance to long-standing risk assessment processes.

For 25 years, the National Institute of Environmental Heath Science's (NIEHS) Superfund Research Program (SRP) has been a leader in developing new data on the basic science of environmental health relative to chemical exposure. However, no components of the NIEHS, EPA, or ATSDR organizational structures had the focused responsibility to bring those research findings to program application in risk assessment processes. SRP decided to explore the research science it had developed over the years for direct application to the risk assessment process. This initiative was the genesis of the Research to Risk Assessment Project (R2RA) project.

R2RA was conceived by the SRP as an innovative approach to bridge the gap between the research community and the risk assessors/risk management practitioners working in the field of hazardous waste cleanup. The approach was to engage experienced senior scientific/technical researchers and practitioners who are strongly interested in pursuing mutually beneficial efforts to advance research, apply research results, and thereby improve public health and the environment.

Purpose and Approach

To increase awareness and understanding of new science to support risk assessments as they are conducted in the field, SRP proposed the establishment of an ongoing communication network of experienced researchers and practitioners at SRP, EPA, and ATSDR. The interagency network was designed to work collaboratively to identify science that was sufficiently developed, or would soon be developed, to enhance some critical aspect of the risk assessment process. The project was intended to meet the mutual needs of EPA, ATSDR, and SRP for demonstrated application and benefits of improved methods of assessing the risk faced by local communities. The focus was on the science, leaving policy issues to the regulatory agencies. The project was supported

by SRP staff and was presented to and supported by the EPA Office of Solid Waste and Emergency Response (OSWER) Assistant Administrator, managers, and staff. The Director of the ATSDR was also very supportive in naming several scientists to represent ATSDR on the R2RA Work Group.

The following have been listed as benefits to the various agencies:

SRP:

- Recognition for SRP's role in providing tools to improve risk assessments
- Input to SRP for future research agenda
- Application of SRP research and its Strategic Plan
- Access to hazardous waste sites
- Publication opportunities

EPA and ATSDR practitioners:

- Incorporation of relevant new science into standard procedures for accessing risk at contaminated sites.
- Better engagement of local communities in the science application and risk communication at hazardous waste sites.
- Reduction of uncertainty in risk assessment decision making.
- New and expanded ongoing channels of communication and research coordination among practitioners and research investigators at EPA, NIEHS, and academic institutions.

The approach included both a short-term focus (primarily for practitioners) and a longer-term focus (primarily for researchers). The project employed a variety of communication tools to bring participants together to assess the challenges of translating new science approaches to "real world" tools that can be used to improve the accuracy and protectiveness of site risk assessments. The project sought to interact with key stakeholders to facilitate dialogue on research results, risk assessors' needs, and how those items could be integrated. It also promoted stakeholders' input to a vision of new science improving public health.

Development of an Interagency Work Group

Success of the project was dependent on having participating agency programs represented by experienced staff. Key individuals from ATSDR, EPA, and NIEHS were

contacted by phone to discuss the project and were invited to participate in the first R2RA conference call in June 2011. The ATSDR Director submitted the names of the Associate Director of Science for these divisions: Health Assessment and Consultation, Health Studies, Regional Operations, and Toxicology and Environmental Medicine, as well as a representative from the Office of Science. EPA Work Group members included the Acting Director and a senior toxicologist from the IRIS program, the senior science advisor for OSWER, two senior staffers from OSWER's Office of Superfund Revitalization and Technology Innovation (OSRTI), two senior risk assessors from the regional offices, a regional community involvement branch chief, the OSRTI associate director for community involvement, and a regional Superfund technical liaison. NIEHS workgroup representatives included a toxicologist from the National Toxicology Program and two senior staffers in the Superfund Research Program. A total of 18 federal employees comprised the initial Work Group membership plus three senior science advisors from the SRP's contractor. Additional federal personnel with expertise in relevant areas were included in the broader communication network.

After the communication network was developed, SRP proposed that the core group of SRP, EPA, and ATSDR senior staff and managers hold a webinar. The purpose of this initial webinar was to develop a mutually acceptable project approach and joint goals for fiscal year 2011. Work group development was a low resource effort using informal, small discussions and occasional face-to-face discussion at scheduled inter-agency meetings. On this first webinar, the participants addressed the following questions:

- What are some ways that new SRP-supported scientific research can be incorporated into the risk assessment process? What are some of the possible hurdles in doing this? What can SRP, EPA, and/or ATSDR do to promote the application of new science in risk and health assessment?
- Can new approaches such as cumulative risk assessment better address community concerns and can SRP help support that? Have communities voiced specific concerns about assessing multiple stressors?
- How would you define success for this project (e.g., involvement of SRP researchers in a specific site risk assessment; input by SRP researchers in an OSWER risk-related guidance; helping to develop a chemical specific-protocol for site risk assessments)?
- Would a communication network be more effective if small groups of SRP researchers and assessors worked on specific problem areas (e.g., specific chemicals or groups of chemicals, cumulative risk)?

Overview of the Work Group Webinar Process

Using webinars for R2RA Work Group discussions allowed the necessary interaction among participants to take place. This facilitated sharing of relevant materials such as documentation of Work Group decisions and convenient summaries of key issues resolved by members.

During the initial June 15, 2011 webinar, the Work Group discussed process, role of members, proposed goals, and next steps for the group. During the second webinar, the Work Group reviewed a list of candidate pilot projects and narrowed the list to the initial three pilot projects. The third and fourth webinars reviewed the progress of pilot projects and discussed approaches for conducting meaningful sessions to lay the basis for the longer term goals of the work group.

The Work Group also reached out to a broader group of relevant experts as needed to address particular science issues raised during the webinars. This allowed the Work Group to be kept at a manageable size, while also enabling consultation on specific science issues. The Work Group also developed a password-protected website within the SRP website to allow ready access of draft and final materials among the work group.

Development of Pilot Project Candidates

The Work Group reviewed and analyzed all the projects conducted by the SRP multiproject center grantees, individual research grantees, and small business innovation research/ small business technology transfer research grantees. The review was intended to identify those projects with research findings that could have near-term application to the science of risk assessment. SRP staff anticipated that the projects selected by EPA and ATSDR would be evaluated for collaborative activities to promote the near-term advanced assessment of risks of hazardous substances in the environment.

This selection process was challenging, but a key part of the R2RA effort. It required an in-depth understanding of EPA and ATSDR program and regional needs, as well as the content and potential for application of the many SRP research programs. SRP staff and their support contractor, MDB, analyzed the extensive SRP research agenda to and organized projects in the SRP research portfolio into groups with possible EPA and ATSDR relevance. MDB and SRP staff developed these groupings based on an evaluation of the state of the research and the potential for the SRP research to meet EPA and ATSDR headquarter and regional needs.

The following is the summary list of candidate SRP research projects that were considered by the R2RA Work Group (See Appendix B for a fuller description of the Superfund Research Program pilot candidates).

- Development and applications of integrated ***in vitro*** and cell-based bioassays
- Biological Response Indicator Devices for Gauging Environmental Stressors (BRIDGES)
- Immunoassays for enhanced detection of toxic substances
- ***In vitro*** test systems to identify developmental neurotoxicants
- Biomarkers of exposure to polycyclic aromatic hydrocarbons
- Exposures to volatile organics
- Arsenic
- Polychlorinated biphenyls
- Analyzing patterns in epidemiologic and toxicologic data
- Computational approaches
- Use of genomic (bioinformatics) tools to predict toxicity

Descriptions of these projects were distributed to the Work Group members to discuss, evaluate, and prioritize during the second R2RA webinar held in September 2011. SRP proposed that specific criteria be used by the Work Group for narrowing the SRP research portfolio to the best candidates for the R2RA project:

- SRP research that could be viewed as advancement of risk assessment practice
- Research matches up with risk assessor needs
- SRP research appears to be ready for site application
- SRP researcher has done work at SF sites
- Research appears to be more broadly applicable to other sites through incorporation in guidance, etc.
- Application to superfund site(s) fits the research design
- Researcher is interested in pursuing research application
- Results from the collaboration could be published in a peer reviewed journal article

Pilot Projects: Selection and Status

There was considerable interaction among the Work Group members to evaluate the potential applicability of each research project to risk assessment. Some Work Group

members volunteered to participate in the subsequent small group effort to initiate the pilot R2RA projects. The Work Group selected these three research projects as pilots:

Airborne PCBs: PCB exposure among school children via inhalation in a school in New York City was proposed as a pilot project; this issue also has broader national implications in that other older school systems may have the same concerns. Current health-based screening levels for PCBs in air rely on extrapolation from the oral Reference Dose (RfD) for Aroclor 1254. EPA's Integrated Risk Information System (IRIS) Program investigated the potential to develop a PCB Reference Concentration (RfC), but the existing inhalation toxicity database is inadequate for this purpose. Additional inhalation toxicity information is needed to develop a representative RfC, which, when developed, will better inform the assessment of risk from this exposure scenario.

The University of Iowa (UI) SRP has extensive, ongoing research in this area and UI researchers are collaborating closely with the EPA New York Regional Office and the EPA IRIS Office. Working together, they developed a short-term, one year PCB research project plan to address the critical need to understand the health effects of airborne PCB exposure. This study is designed to fill a major data gap regarding the health effects of inhaling PCBs. These data will allow EPA to more meaningfully assess health risk of airborne PCB exposure with a lower degree of uncertainty.

Successful completion of the study in rats designed by both EPA and the University of Iowa SRP to adequately support a reference concentration in air will have significance to all EPA regulatory programs that deal with PCB exposure and toxicity, including school districts and other contaminated regions in many major U.S. cities. Reducing the level of uncertainty with regards to health risks addresses the threat of current airborne PCB exposure for millions of school children. It also has the potential to save millions of dollars in remediation costs by providing a more accurate and attainable PCB concentration in the air where no health effects are observed.

The NIEHS SRP has committed to funding toward this study and senior leadership at EPA National Center for Environmental Assessment is actively pursuing additional funding to support prompt initiation of the study.

Vapor Intrusion: Vapor intrusion is an emerging concept and requires research and collaboration to better understand the exposure pathways of these vapors and their effects on human health. Vapor intrusion has been found to occur at hundreds of sites around the country, and both EPA and ATSDR are developing and updating guidance materials to address vapor intrusions issues.

Researchers at the Brown University SRP are working to develop a robust three-dimensional model of the vapor intrusion phenomenon to better understand the risk

from the exposure of vapors that contaminate indoor air from groundwater and soil. This tool will allow regulators and other concerned parties the ability to model results to more effectively and guide site investigation and remediation efforts.

R2RA is coordinating interactions between the Brown SRP Center and EPA and ATSDR to establish a mutually beneficial exchange of information about vapor intrusion research efforts. EPA and ATSDR have provided data sets from hazardous waste sites to Brown researchers. These data will enable the researchers to further develop and validate the three-dimensional computational fluid dynamics model.

In a similar vein, SRP researchers at the Brown University SRP are assisting EPA and ATSDR in their ongoing site-specific assessments of potential soil vapor intrusion at contaminated sites around the country.

This R2RA effort may also evolve to provide additional scientific insights into the national assessment of soil vapor intrusion and future guidance development.

Passive Sediment Sampler: Sediment is a major source of contamination at Superfund sites. The Oregon State University SRP is doing site-specific research on the use of a passive sampler developed by Kim Anderson that could be very helpful to EPA Region 10 and other EPA Regions and states in assessing the nature of the hazards posed at these sites. There could be broader national implications in the evaluation of sediments, the use of passive sampler technology, and in the application and acceptance of new analytic methods to address sites.

Work Group Suggestions for Other Types of "Spin off" Pilot Projects and "Mutual Understanding" Webinars

The Work Group determined that its longer term goals would best be achieved through efforts to break down the "silos" among the agencies, the research community, and the environmental program/field practitioner communities. Greater mutual understanding could be achieved, in part, through webinars that explored the different EPA and ATSDR field practitioners, Headquarters staff, and SRP research communities› working environments, time frames, metrics, and incentive systems. The Work Group decided that the two most beneficial discussions would cover the EPA Integrated Risk Information System (IRIS) and Provisional Peer Reviewed Toxicity Values (PPRTV) processes and the regional/field exposure/risk assessment processes.

After the selection of the first three pilot projects, Work Group members identified additional areas where EPA or ATSDR needed additional scientific collaboration. These

areas usually had short-term time frames and/ or were site-specific in nature and included:

Region 10 RARE project: EPA Region 10 asked for SRP researchers to provide short-term expertise (by conference calls) to assist their scientists who were scoping out a Regional Applied Research Effort (RARE) study to assess the nature of threats at a Superfund site in the region. SRP research scientists from Columbia and Dartmouth participated in two conference calls and email communication to provide insights and technical assistance to the EPA team that was preparing the site specific study design. Region 10 expressed their appreciation for this quick turn- around responsiveness by these SRP researchers.

Phosphate Amendments: EPA Region 2, along with Region 9 and OSRTI, are considering regional concerns with the effectiveness of the use of phosphate amendments to treat lead-contaminated soils at hazardous waste sites. SRP scientists from the University of Arizona and Columbia University are providing their expertise to and EPA study design to assess the application and limitations of this technology, particularly in terms of its application to urban gardening. For example, SRP and EPA staff collaborated to organize a scientific session at the Fall 2013 American Chemical Society National Meeting, entitled “Biogeochemical Interactions Affecting Bioavailability and Remediation of Hazardous Substances in the Environment”.

Collaboration on recently listed NPL sites: EPA recently listed, on the National Priorities List, a site that is contaminated with uranium. The R2RA Work Group is exploring how it could provide scientific support to the EPA in the assessment of the hazards at this site, which could serve as a model of other site-specific support that SRP researchers could provide to EPA and ATSDR.

R2RA’s Evolving Goals and Next Steps

The initial concept of R2RA was for the interagency Work Group to begin exploring the complex issues associated with advancing the field of risk assessment , including of the new science of genomics and other biological and toxicological developments. Many of the SRP grantees have ongoing research in these cutting edge areas. The pilot efforts and the shorter-term “spin-off” projects have proven successful in promoting collaboration, the mutually beneficial application of research results, and the reduction of uncertainty in hazardous substance/hazardous waste risk assessment.

The challenge that the R2RA Work Group faces is building on these successful short-term collaborations and extrapolating from these efforts to a continuing, longer-term effort. The R2RA project is evolving to address the more complex issues of exposure

and toxicity that might lead to a new risk assessment paradigm as described at the beginning of this report. Addressing these profound issues is part of its long-term goals.

At many forums where cutting-edge science application to risk assessment is discussed, participants concluded that it may take many years to fully incorporate developing areas of science into risk assessment practice. This is largely because new science is revealing the wide variation in biological responses by individuals to insults at the cellular level and the complexity of gene interaction. Assumptions of a generalized "safe dose" for chemical exposure now take on greater complexity for risk-based decision-making.

In addition, assessment of risk from cumulative exposure to combined environmental insults (i.e. considering all the possible combinations and permutations of chemical mixtures and individual responses) complicates the issue even further. A structure within federal agencies is needed to continually evaluate how environmental risk can be effectively assessed as this science continues to unfold. The R2RA project can serve as an emerging instrument to keep a visible focus on this issue among relevant federal agencies and facilitate cross-agency collaboration in pursuing this goal. This long-term goal may be achieved by either incremental steps or potentially through future collaborations.

The R2RA has an active agenda planned for its future. The key issues to pursue include:

- Proceeding with the ongoing pilot projects to achieve the goals established for the unique needs of each effort;
- Implementing a mutual understanding organizational interaction program to improve research science application more broadly in the future; and
- Further exploring the longer term application of cutting-edge research to enhance the risk assessment processes used in the field.
- Continuing to evaluate the successes and lessons learned from each pilot to apply to future pilots and any potential broader applications across SRP, EPA, and ATSDR programs;

APPENDIX A

R2RA Interagency Work Group Members

Research to Risk Assessment Project Participants List

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APPENDIX B

Initial List of R2RA Pilot Project Candidates

This is the initial list of SRP research projects that were proposed for the R2RA to consider as potential collaboration pilots to mutually benefit EPA or ATSDR as well as the SRP researchers.

*A. Development and Applications of Integrated **In Vitro** and Cell-Based Bioassays*
Investigator: Michael Denison, University of California-Davis

Accurate identification and quantitation of dioxin-like halogenated aromatic hydrocarbons (HAHs) in environmental matrices are critical for site assessment, risk assessment, and environmental monitoring. Denison's research team has developed and validated the XDS-CALUX® bioassay, which is sensitive to <1 part per trillion for dioxin/furan and polychlorinated biphenyls (PCB) analyses. Denison has thoroughly validated the method, including participation in the EPA SUPERFUNDINNOVATION TECHNOLOGY EVALUATION (SITE) program and receipt of EPA approval for publication in EPA'S TEST METHODS GUIDANCE (SW-846). The assay is applicable to: biological matrices including blood (whole serum and extracts), breast milk, and tissues extracts; environmental matrices including soil and sediment, ash, and pulp and paper; and food matrices including animal fats (oil and fats), milk and butter, and animal feeds. CALUX has been used in epidemiologic studies and to evaluate the safety of food and drinking water sources primarily in Belgium, Japan, Poland, and to a limited extent in the United States. CALUX has been demonstrated as a faster, cheaper analytic method for Dioxin and PCBs sites which does not entail the reliance on more time consuming laboratory GC/MS methods and could be used for more extensive sampling to reduce uncertainty in site specific exposure assessments.

B. Biological Response Indicator Devices for Gauging Environmental Stressors (BRIDGES)
Investigator: Kim Anderson, Oregon State University
Anderson refined and combined two technologies to assess the toxicity of bioavailable contaminant mixtures present in the environment. Building upon lab work and field trials conducted at a Superfund megasite in the lower Willamette River in Oregon, her research team created a bio-analytical tool that can assess multiple biological responses to environmentally relevant mixtures similar to the responses in a whole organism vertebrate model. The passive sampling has the potential for broad application to a wide range of contaminants at Superfund sites for determining more accurate exposure levels for risk assessments.

C. Immunoassays for Enhanced Detection of Toxic Substances

Investigators: Bruce Hammock and Shirley Gee, University of California-Davis

Immunoassay tools developed by Gee's team have been utilized by state governments and university researchers to gather more comprehensive information on the relationship of human exposure to environmental chemicals. For example, the researchers have developed assays to detect pesticides including paraquat, permethrin, fipronil and chlorantraniliprole; brominated flame retardants; and antimicrobial compounds in environmental (soil, water, sediment) or biological (urine, blood, saliva) matrices. The standardization and verification of these methods for Superfund contaminants would have direct application to site investigations by EPA and ATSDR.

*D. **In vitro** Test Systems to Identify Developmental Neurotoxicants*

Investigator: Ted Slotkin, Duke University

Slotkin's research team designed an *in vitro* test system using PC12 cells, a cell line that recapitulates the critical stages of neuronal development ranging from cell replication through differentiation and axonogenesis. This system has the potential of providing a rapid and relatively inexpensive method to evaluate cumulative toxicity of contaminants across chemical classes found at Superfund sites thereby influencing the risk assessment and health assessment.

E. Biomarkers of Exposure to Polycyclic Aromatic Hydrocarbons

Investigator: James Swenberg, University of North Carolina at Chapel Hill

Swenberg demonstrated significant correlations between PCB exposures, liver adducts (i.e., M1dG), and incidence of liver toxicity/tumor development. This work provides environmental health researchers and risk assessors with a new, sensitive biomarker of exposure to dioxin-like compounds.

Investigators: Martyn Smith and Stephen Rappaport, University of California-Berkeley

The results of research led by Rappaport and Smith suggest that the leukemia risk associated with exposures to environmentally relevant levels of benzene could be substantially greater than currently assumed for the general population, and even higher for subgroups with specific genetic susceptibilities. (In addition, other work on the physiological and genetic aspects of PAH exposure by Swenberg and Rappaport could have application for the study of other hazardous organic substances for improving the science of toxicity and exposure for use in risk assessments at Superfund sites.)

F. Exposures to Volatile Organics

Investigators: Kelly Pennell and Eric Suuberg, Brown University

This research team is exploring the broad range of variables that impact vapor intrusion exposure by both constructing computational methods for predicting properties such as vapor pressures and water solubility and field testing in an

affected neighborhood. Multiple volatiles and semi-volatiles can diffuse differentially, making the actual exposures a different mixture from the source of contamination. This work could help cumulative risk assessment by providing a better tool for estimating mixture concentrations during exposure.

Investigator: Mark Brusseau, University of Arizona
Dr. Brusseau is conducting a systematic study of the mass-transfer behavior of chlorinated-solvent immiscible liquids at multiple scales, and investigating the impact of system properties on mass flux and plume response. His work involves integrated pore-scale, intermediate-scale, and field-scale investigations at a Superfund site, as well as mathematical modeling analysis. He defines the overall goal of the research as enhancing the accuracy of risk assessments and improving the effectiveness of remediation strategies for sites contaminated by chlorinated solvents.

G. Arsenic

SRP has invested in arsenic research for 25 years, funding work in engineering, biomedical science, geology, chemistry, nutrition, and community engagement. The extensive data from these programs could be mined in a coordinated effort to investigate a wide variety of health and exposure topics.

Columbia University
ttp://tools.niehs.nih.gov/srp/programs/sbrp_Project_list.cfm?Project_ID=P42ES10349

Dartmouth College
http://tools.niehs.nih.gov/srp/programs/sbrp_Project_list.cfm?Project_ID=P42ES7373

University of Arizona
http://tools.niehs.nih.gov/srp/programs/sbrp_Project_list.cfm?Project_ID=P42ES4940

University of California-Berkeley
http://tools.niehs.nih.gov/srp/programs/sbrp_Project_list.cfm?Project_ID=P42ES4705

H. Polychlorinated biphenyls (PCB)

Development of Environmental Sampling Devices
Damian Shea, University of North Carolina at Chapel Hill
Shea is advancing the use of passive sampling devices (PSD) to measure the bioavailable fraction of PCBs and PCB metabolites in water, sediment, and soil. He is conducting laboratory bioavailability experiments with PCB-contaminated soil, sediment and water to advance scientific understanding of the mechanisms controlling PCB bioavailability and perform field verification at NPL sites.

Airborne PCBs

University of Iowa Superfund Research Center
Investigators: Keri Hornbuckle

Airborne PCBs are the focus of both research and community engagement efforts at this project. Hornbuckle's project seeks to determine the source and fate of airborne PCB congeners in Chicago air using a novel sampling method. Thorne's project focuses on PCB exposure of a Chicago cohort and determines emission levels at homes and schools in order to develop exposure profiles. Robertson's project brings coordination of a multidisciplinary approach to the UI projects that study the source, exposure and toxicity of PCBs in the Chicago area and in the laboratory..

J. Analyzing Patterns in Epidemiologic and Toxicologic Data

Investigators: Thomas Webster and Ann Aschengrau, Boston University
This research group is using generalized additive models (GAMs), an extension of logistic regression, and corresponding statistical tests to evaluate whether there is an association between geographic location of residence and disease. These tests are used to determine whether there is some unmeasured environmental exposure putting participants at greater risk. This has interesting possibilities for using computational approaches to discover non-chemical stressors or even background chemicals that are problematic at a site.

K. Computational Approaches

Investigator: Sandor Vajda, Boston University
These researchers have studied a number of specific problems which relate to using genomic (bioinformatics) tools to predict toxicity. This could be useful in deciding which chemicals at a Superfund site might be problematic, and which chemicals should be grouped for the purpose of looking at dose additively.